

Nuclear Thermal Propulsion (prior to FY15: Nuclear Cryogenic Propulsion Stage) Project

Advanced Exploration Systems Program | Human Exploration And Operations Mission Directorate (HEOMD)



ABSTRACT

A key goal of the project is to address critical, long-term nuclear thermal propulsion (NTP) technology challenges and issues through development, analysis, and testing of NTP hardware so NTP systems can be an affordable and viable in-space propulsion candidate for future HEO missions. An important NTP technology challenge is advancing the maturity of the NTP fuel by confirming that NTP fuels from the previous NERVA/Rover period can still be made and can perform as demonstrated in the past. First generation NTP systems and fuel technologies that are consistent with and can meet requirements of the initial crewed Mars Surface Missions will be the primary focus for NTP hardware development/testing for the project.

AES completed this project at the end of FY15 (September 30, 2015). In FY16, STMD will initiate a new nuclear thermal propulsion activity within their Game Changing Development Program with a different focus.

(Prior to FY15, the project name was: Nuclear Cryogenic Propulsion Stage Project)

ANTICIPATED BENEFITS

To NASA funded missions:

Not applicable to currently funded missions.

To NASA unfunded & planned missions:

Some of the benefits for NTP are significant mission cost savings by avoiding extra launches for a given mission, avoiding the need to develop Mars aerocapture technology since NTP would use nuclear propulsion to brake at Mars, and potentially avoiding additional radiation counter-measures or shielding for crew due to shorter mission trip times.

To the commercial space industry:

Same as "Anticipated Benefit to NASA for Unfunded/Planned

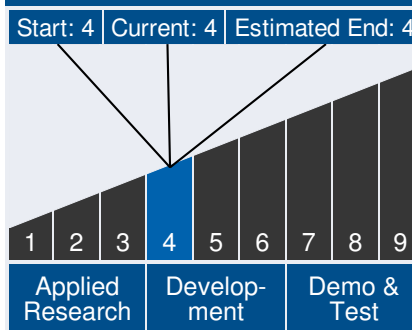


Nuclear Thermal Propulsion (NTP)

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Technology Maturity



Management Team

Program Director:

- Jason Crusan

Program Executive:

- John Warren

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Missions" above.

To the nation:

Same as "Anticipated Benefit to NASA for Unfunded/Planned Missions" above.

DETAILED DESCRIPTION

Key NTP project objectives are to conduct preliminary design, fabrication, and test of representative fuel samples and partial length fuel elements for previous NERVA/Rover fuels types to verify that these fuel forms can still be made and perform as demonstrated in the past; further define preliminary NTP system concept designs that can meet the requirements for Crewed Mars Surface Missions requirements and serve as a basis for the candidate NTP fuel elements/types for both a smaller demonstration sized engine (~16 klbf) and a larger Mars Crewed Vehicle sized engine (25 klbf); and using the results of the above efforts as well as other heritage NTP data, develop fuel downselection criteria and recommendations to support an NTP fuel type leader selection. This NTP fuel leader selection, graphite composite fuel, was made in March 2015.

(Prior to FY15, the project name was: Nuclear Cryogenic Propulsion Stage Project)

Management Team (cont.)

Project Manager:

- Doyce Mitchell

Principal Investigator:

- Michael Houts

Technology Areas

Primary Technology Area:

In-Space Propulsion

Technologies (TA 2)

└ Non-Chemical Propulsion (TA 2.2)

└ Thermal Propulsion (TA 2.2.3)

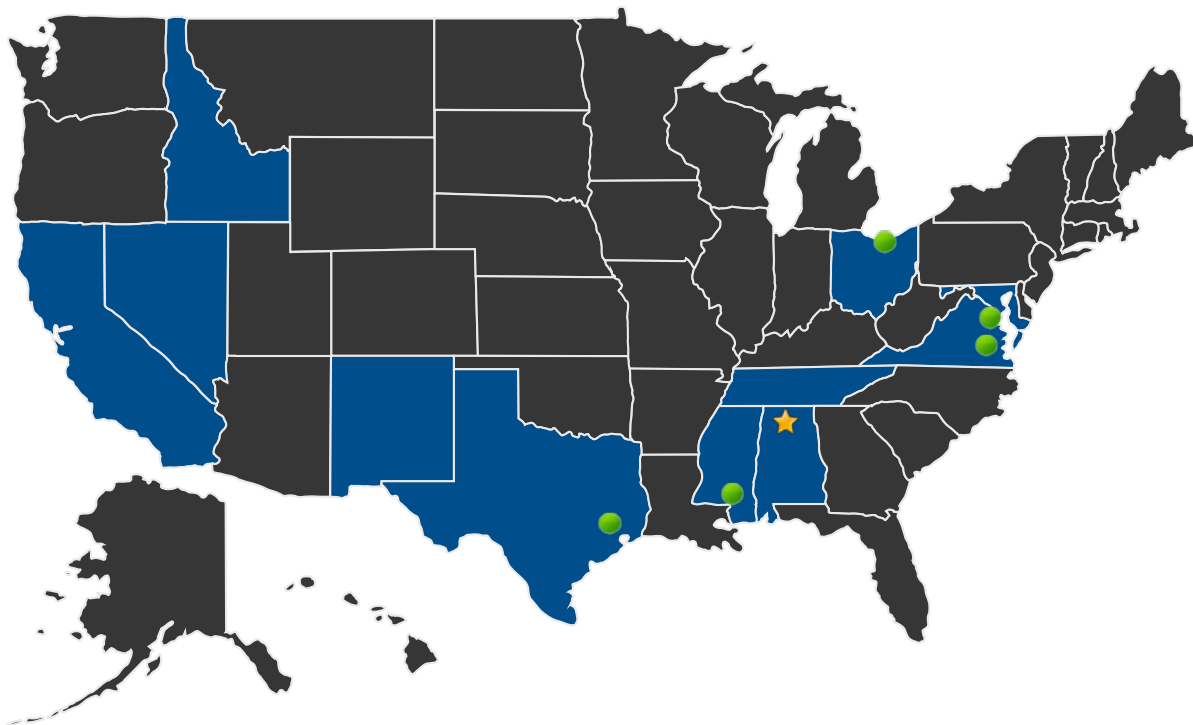
└ Nuclear Thermal Propulsion (NTP) (TA 2.2.3.2)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ **Lead Center:**
Marshall Space Flight Center

● **Supporting Centers:**

- Glenn Research Center
- Johnson Space Center
- Langley Research Center
- NASA Headquarters
- Stennis Space Center

Other Organizations Performing Work:

- Aerojet-Rocketdyne
- Center for Space Nuclear Research
- Department of Energy (HQ, INL, LANL, NNSA, NSTec, ORNL)

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DETAILS FOR TECHNOLOGY 1

Technology Title

Nuclear Thermal Propulsion (NTP) (prior to FY15: Nuclear Cryogenic Propulsion Stage)

Technology Description

This technology is categorized as a hardware system for manned spaceflight

Key NTP project technology objectives are to conduct preliminary design, fabrication, and test of representative fuel samples and partial length fuel elements for previous NERVA/Rover fuels types to verify that these fuel forms can still be made and perform as demonstrated in the past; further define preliminary NTP system concept designs that can meet the requirements for Crewed Mars Surface Missions requirements and serve as a basis for the candidate NTP fuel elements/types for both a smaller demonstration sized engine (~16 klbf) and a larger Mars Crewed Vehicle sized engine (25 klbf); and using the results of the above efforts as well as other heritage NTP data, develop fuel downselection criteria and recommendations to support an NTP fuel type leader selection. This NTP fuel leader selection, graphite composite fuel, was made in March 2015.

Capabilities Provided

This technology provides very high performance capability - initial NTP systems would offer almost twice the specific impulse (900 seconds) of the best chemical engines while also providing relatively high thrust. Also, this technology would enable reduced IMLEO requirements and thus fewer required launches for Crewed Mars missions, reduced trip times for Mars and other destinations, and the possibility of providing both power and propulsion from the same nuclear system.

Potential Applications

This technology has potential applications for advanced in-space propulsion systems for future human and robotic exploration missions that need to travel faster and deeper into the solar system than current SOA systems allow.

Performance Metrics

Metric	Unit	Quantity
Specific Impulse (Isp)	seconds	900